4/9/97
DCJ

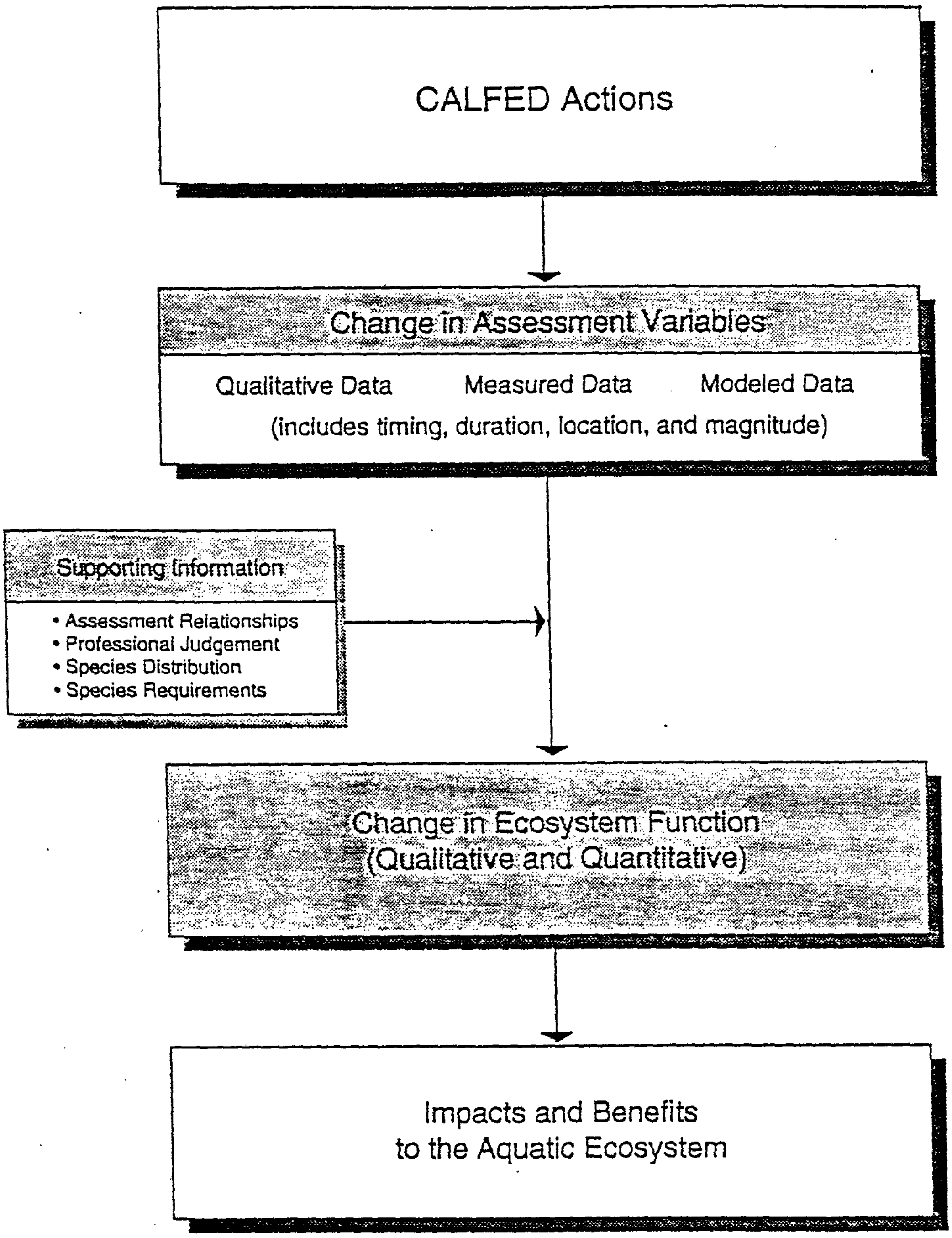
APPROACH TO IMPACT ANALYSIS

Program Coordination Team Meeting

Wednesday, April 9, 1997

E-010118

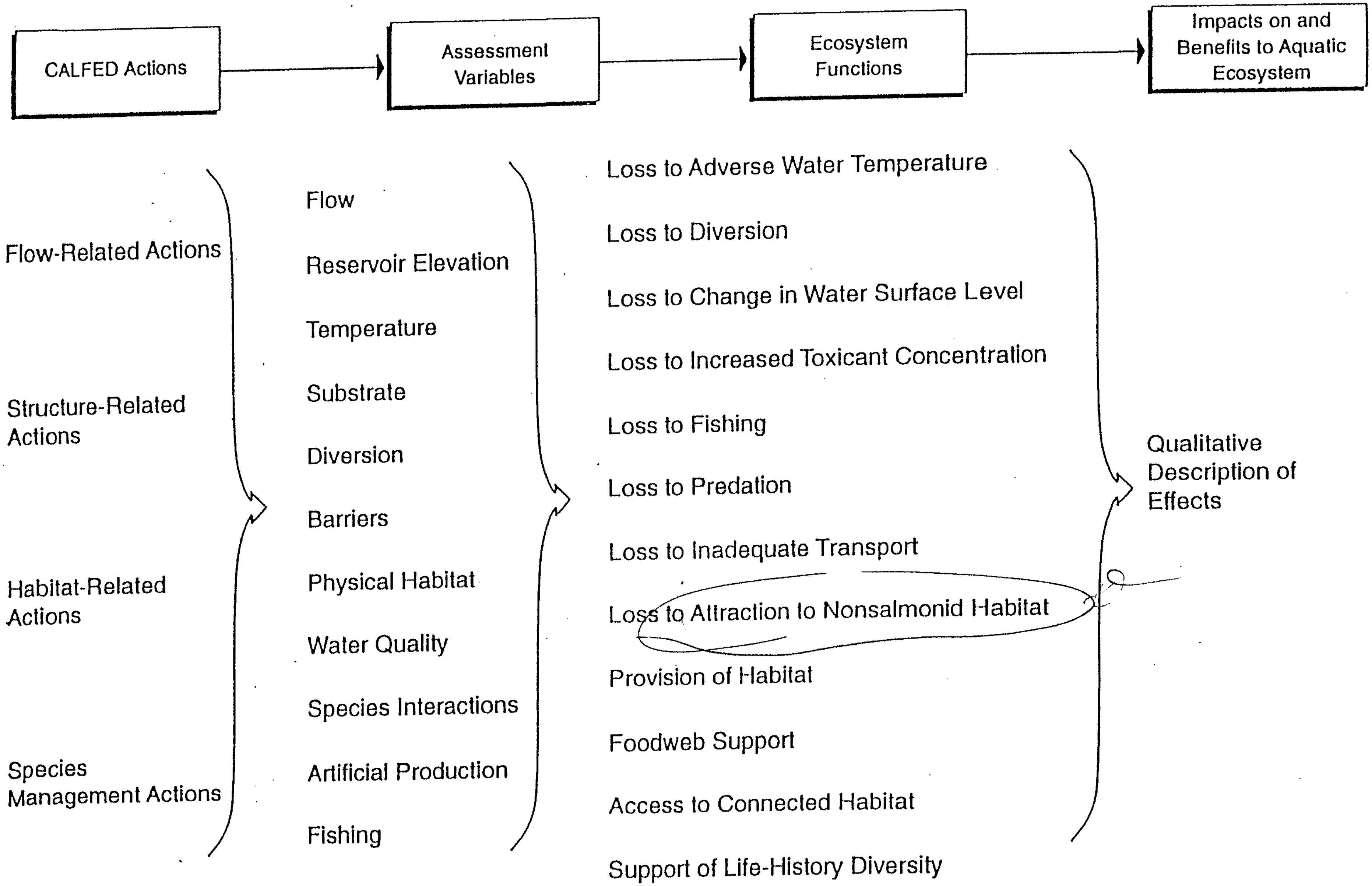
E-010118



CALFED
BAY-DELTA
PROGRAM

Figure 2
General Assessment Method for Fish and the Aquatic Ecosystem

E-010120



CALFED
BAY-DELTA
PROGRAM

Figure 1
Pathway for Linking CALFED Actions to Impacts and Benefits

E—010120

2

LOSS TO DIVERSION

ASSESSMENT VARIABLES:

- physical habitat
- diversions
- barriers
- species interactions
- flow

ASSESSMENT RELATIONSHIPS:

1) fish screens and fish screen improvements reduce entrainment and impingement and reduce diversion loss.
   Measured indicators: **proportion of diverted flow with fish screens**

2) increased diversion or the proportion of flow and channel volume diverted increases diversion loss.
   Measured indicators: **diversion volume, channel volume, net flow, and tidal flow**

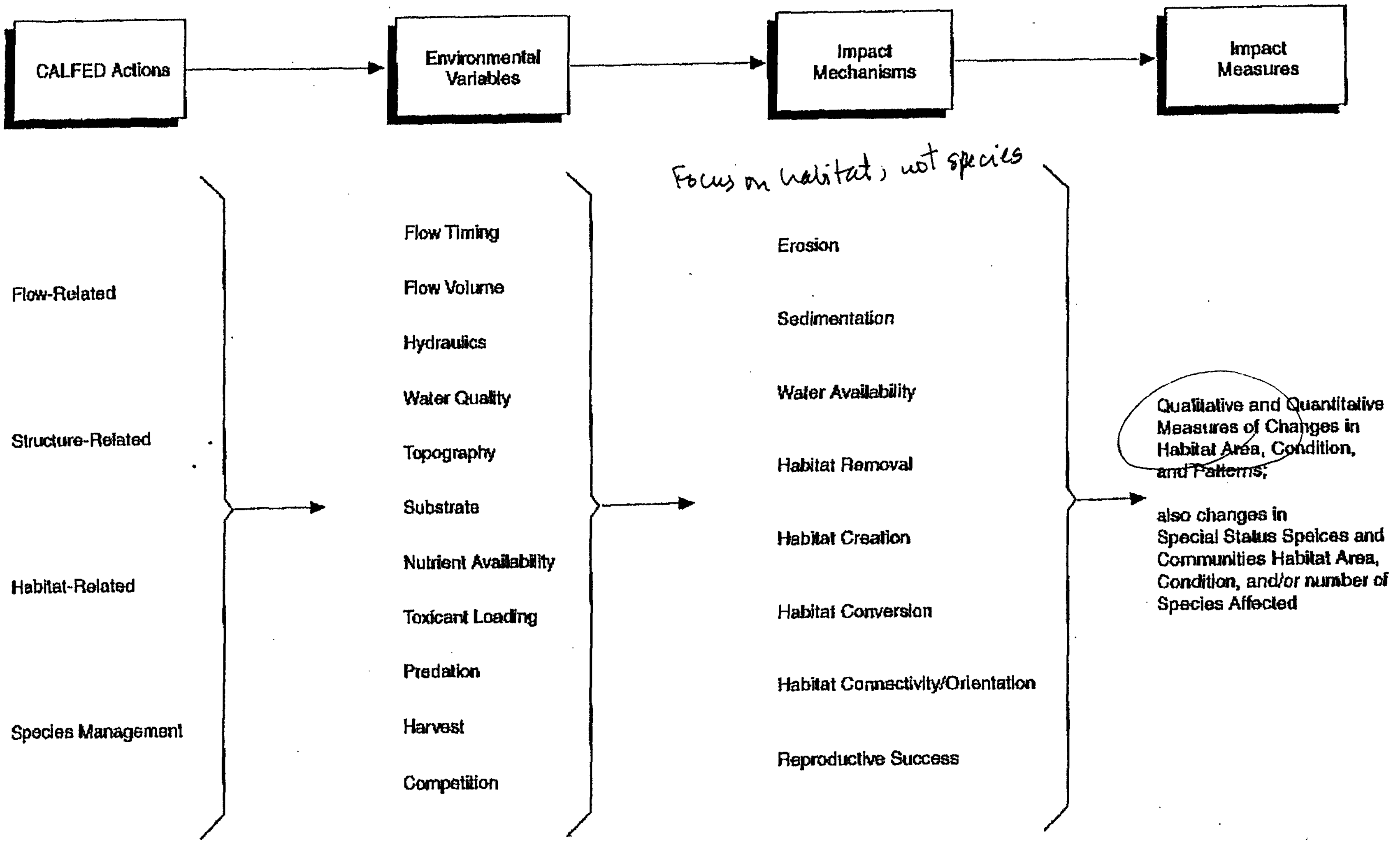
3) upstream relocation of X2 increases diversion-related losses.
   Measured indicators: X2

4) predator removal at diversion facilities reduces diversion loss.
   Measured indicators: **location and number of diversions with predator removal programs or programs to redesign facilities to reduce prey vulnerability**

Species	Life Stage				
	Adult Migration	Spawning/Incubation	Larval Rearing	Juvenile/Adult Rearing	Juvenile Migration
White sturgeon			●	●	●
Chinook salmon			●	●	●
Steelhead trout			●	●	●
American shad		●	●	●	●
Sacramento splittail	●			●	●
Striped bass		●	●	●	●
Delta smelt	●		●	●	●
Longfin smelt	●		●	●	●
White catfish				●	
Rotifers			●	●	
Native mysid shrimp			●	●	

DISCUSSION: QUALIFIERS AND CAUTIONS

Information on diversion location, duration, timing, and size may be needed. Distance of diversion opening from main flow, vertical location of diversion



CALFED
BAY-DELTA
PROGRAM

Figure 1
Pathway for Linking CALFED Actions to Impacts and Benefits

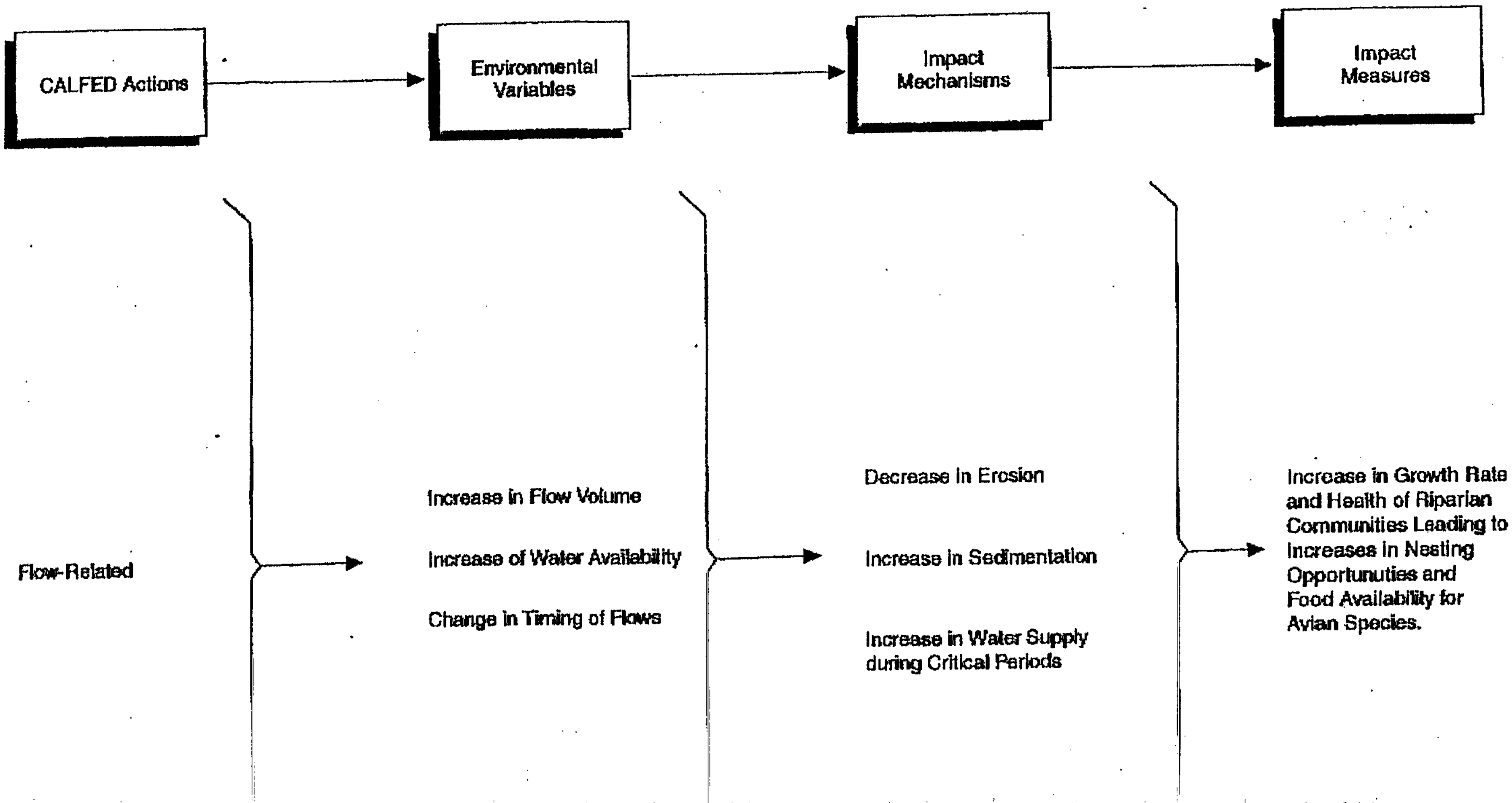
59634-#000/040797/graphics/mcl

TOTAL P.22

E-010122

E-010122

(4)


CALFED Actions
Environmental Variables
Impact Mechanisms
Impact Measures
Flow-Related
Increase in Flow Volume
Increase of Water Availability
Change in Timing of Flows
Decrease in Erosion
Increase in Sedimentation
Increase in Water Supply during Critical Periods
Increase in Growth Rate and Health of Riparian Communities Leading to Increases in Nesting Opportunuties and Food Availability for Avian Species.

E-010123

HYDROLOGY & WATER MANAGEMENT

Water management encompasses all facilities and operating procedures which affect the storage and movement of water. It includes the construction and operation of dams, canals, levees, pipelines, fish screens, pumping plants, wells, water and wastewater treatment facilities, irrigation facilities, and municipal water distribution systems. Water Management provides various benefits, including flood control, water supplies, recreation, navigation and wildlife habitat. It also alters the natural hydrologic processes with a wide range of environmental impacts.

A wide range of assessment methods are available to evaluate the effects of water management alternatives on the storage and movement of water, as well as secondary effects on water quality and water dependent resources. The following methods are expected to play key roles in the assessment process for the Programmatic EIR/EIS:

Estimates of natural flows which would occur in the absence of water management facilities and procedures are computed on a monthly basis for all significant tributaries of the Sacramento-San Joaquin Delta. The resulting estimates are referred to as Full Natural Flows or Unimpaired Flows. These computed monthly flows provide the foundation for a variety of water supply forecasting and water management simulation models.

Accounting models which simulate the operation of the major water management facilities of the Delta and its tributaries are probably the most important analytical tools. The State Department of Water Resources maintains and operates DWRSIM, which the U.S. Bureau of Reclamation operates PROSIM. Although these are referred to as simple water accounting models, in practice they are extremely complex. The reason is that in order to provide realistic simulation, they must incorporate the many complex operating criteria, agreements, and standards, as well as the physical characteristics of facilities throughout the system. It is likely that the CALFED Bay-Delta Program will rely primarily on DWRSIM.

DWRSIM is designed primarily to address surface water facilities management and water use. It is currently not well suited for management of complex programs for the conjunctive use of groundwater and surface water. Efforts are currently underway to modify the model to adequately simulate such programs.

The Sacramento-San Joaquin Delta, with its many interconnected channels, tides, and varying inflows is extremely complex and dynamic. In order to adequately model the hydrologic, hydrodynamic, and water quality processes of the Delta, models must go beyond accounting for monthly water volumes. A number of models are available to simulate the effects of natural processes and water management facilities operations. Those in current use for assessment of water management options operate on a computational time step short enough to capture the effects of twice daily tidal variations. They treat the Delta as an interconnected network of channels and nodes. For each time step, the flows, velocities, and stages throughout the system are computed as a function of channel geometries, channel roughness, inflows, tides, and the previous time step results. The Department of Water Resources currently employs DWRDSM1, which is a proprietary model derived from the Fischer Delta Model. A new model, DWRDSM2, promises to offer improvements in the representation of channel geometries and also offers the advantage of being non-proprietary. It is currently under development.

Delta water quality is linked very closely to water management activities and indirectly to a wide range of human actions. Models which simulate the movement of water throughout the system will therefore provide the conceptual foundation for water quality impact evaluations, and are therefore mentioned here for completeness. A Delta salinity simulation model is linked to the hydraulic simulation model within DSM1. In addition, a Trihalomethane Precursor tracking model may be used to simulate the genesis, dispersion, and chemical changes of trihalomethane precursors in the system.

Flood events in the Delta are also extremely dynamic and complex. To accurately represent historic events they must cope with sudden and dramatic changes in conveyance and storage capacities in the system resulting from levee breaks and inundation of vast tracts of land. Several simulation models may be used together to adequately simulate historic events and predict the effects of proposed water management options. These include HEC1, which is used to simulate rainfall-runoff processes, operations of flood control reservoirs, and routing of floods across the valley floor. The National Weather Service DWOPR model and the Corps UNET model may be used to simulate dynamic flood flows in Delta channels and levee failures. HEC2 can be used to simulate steady-state flood profiles, and thus provide a convenient tool for checking the results of DWOPR and UNET by comparing flood profiles during flood peaks.

This description of analytical tools is not exhaustive. Specialized tools for examining channel flow and velocity distributions may be used to evaluate diversion and fish screening facility options (ie RMA2). Simulation of water temperatures, oxygen content, and other important characteristics will be conducted as necessary to meet the goals of an adequate programmatic evaluation.

LEVEE SYSTEM INTEGRITY

CALFED Bay-Delta Program objectives for maintaining levee system integrity include managing risk to land use, economic, infrastructure, water quality, and ecosystem functions and values. The Levee Impacts team will use a four step approach to analyzing potential impacts on the flood protection system, including:

- Step 1. Describe Existing Conditions of the Levee System
- Step 2. Identify CALFED Actions that Could Affect Levee System Integrity
- Step 3.. Identify Flood Control System Impact Types by Alternative
- Step 4. Recommend Flood Control System Mitigation Measures

Step 1. Describe Existing Conditions of the Levee System

Literature documenting existing conditions on Delta and tributary levees will be reviewed and summarized to provide overviews of current levels of flood protection. Summaries of seismic and structural stability will be presented for generalized regions within the delta, and for each major tributary system. Levels of protection will be summarized and presented as existing conditions to support a programmatic analysis of potential impacts to the integrity of the entire interdependent Delta and tributaries flood control system.

Step 2. Identify CALFED Actions that Could Affect Levee System Integrity

Several CALFED actions could affect levee system integrity. Examples of the types of actions that will be evaluated for their impacts on flood control operations, storage capacity, flood routing, and emergency response capabilities include:

- Storage - reservoir re-operations, enlargement, or construction (on- and off-stream), and aqueduct storage;

- Conveyance- isolated facility construction, operation, and maintenance, flow control structures, channel enlargements with existing leve removal and new setback levee construction, open channel construction. channel dredging, and floodway modifications;

- Ecosystem - meander belts, levee breaching, fish control barriers, aquatic habitat conversions, wetlands habitat creation, riparian habitat creation, waterfowl habitat management, management of channel hydraulics, inflow, and outflow;

- Water Quality - flow control barriers, detention basins, storage basins, discharge timing changes, contaminant dilutions, recycling, and intake relocations; and,

- Levee System Integrity - standard rock revetment (riprap), waterside berms and riparian habitat, landside berms and habitat, setback levees, subsidence and construction-related impacts.

The scope of potential impacts to the levee system will be presented as ranges in storage and conveyance capacities, flows, inundated acreages, miles of channel and levee improvements, and acres of habitat restoration improvements.

Step 3. Identify Flood Control System Impact Types

Significant and nonsignificant flood control system impacts from one or more actions will be identified for each alternative, and presented within one of five categories indicating reduced system integrity, including:

1. Levee Design
2. Landside Slope
3. Waterside Slope
4. Channel Configuration, and
5. Hazards

The Levee Design category will include short-term construction impacts, and long-term impacts with direct bearing on future levee design. Primary adverse impacts increasing levee instability, subsidence, settlement, seepage, and wave run-up will be identified. The Landside Slope category will include primary stability, seepage, distress and inspection impacts. The Waterside Slope category will include primary stage, stability, slope protection, seepage, and scour potential impacts. The Channel Configuration category will include primary stage, stability, seepage, wind-fetch erosion, scour potential, sedimentation, and channel capacity impacts. Secondary impacts potentially affecting maintenance, repair, and emergency response will be addressed in each of these categories. The Hazards category approach will estimate impacts based on deployments needed to increase system integrity for high-priority, functionally important system components that protect regional economic, flood control, and environmental values.

Step 4. Recommend Flood Control System Mitigation Measures

Flood control system mitigation measures will be recommended for significant adverse impact types identified in Step 3. Mitigation may include adjustments in the phasing of emergency response measures and system-wide flood protection improvements. Structural and non-structural mitigation options will focus on minimizing short-term construction impacts, and impacts to long-term flood protection system operation and maintenance. Mitigation measures will be summarized and presented in tables to facilitate a direct comparison of impacts and mitigation measures between alternatives.

WATER QUALITY

1. Revise water quality action statements to be compatible with the Programmatic EIR/EIS.

   Through the public participation process, 32 water quality actions were identified that, when implemented, would be expected to improve water quality conditions with respect to the Parameters of Concern. A number of these are means-specific, such as the action to reduce concentrations of selenium by using impoundments for storage and timed release of agricultural drainage. At the Programmatic level, it is appropriate to identify what action will be taken and generally where, but not exactly how. This action might be rewritten to say "*Reduce selenium concentrations in the San Joaquin River and Delta from subsurface agricultural drainage in the Grasslands Area of the San Joaquin Valley.*" Alternatives for accomplishing this action might include drainage treatment, impoundment and timed release, and land use conversion. The choice among these alternatives would be made based on project-specific environmental documentation in Phase III of the CALFED program. When written in a manner consistent with the Programmatic EIR/EIS, the number of water quality actions should be smaller.

2. Establish *Performance Targets* and *Environmental Targets* for the actions.

   Performance targets will be a realistic estimate of the level of improvement is feasible and be based, wherever possible, on actual studies or other supporting basis. Environmental Targets will identify what the condition looks like when the problem is resolved. Water Quality Control Plan objectives, where they exist, will be used as Environmental Targets. As an example, an action might be written "*Reduce concentrations of copper, zinc, and cadmium from abandoned and inactive mines in the Upper Sacramento River watershed*". The Performance Target might be to reduce the copper loading from 30,000 lbs/year to 5,000 lbs/year, based on studies that have been done of the problem and the estimated feasibility of accomplishing this target. Zinc and cadmium concentrations would be reduced as well, as the source is the same. The Environmental Target might then be the Water Quality Control Plan objective of 5.1 ug/L copper in the Sacramento River above Hamilton City.

   Establishment of Performance Targets is quite necessary to developing an accurate picture, at the Program Level, of what water quality actions are likely to be implemented, the degree to which the actions would be implemented, and what impacts are to be expected. This work could be classified as prefeasibility study but, as it is fundamental to impact analysis, it can equally be classified as a component of impact analysis.

3. Identify water quality problem areas that will define the geographic areas in which water quality actions and associated impacts will occur. The Clean Water Act Section 303(d) list of impaired water bodies will be utilized as the basis for identifying problem areas.

4. Identify generalized impacts of the water quality actions. This activity will be

undertaken in parallel to action statement refinement, establishment of water quality targets, and identification of water quality problem areas for impact analysis. When action statements have been refined and their geographic locations better defined, potentially significant impacts will be identified more specifically.

5. Identify generalized impacts of other CALFED actions on water quality. As the actions of other resource areas are better defined during the process of alternative development, potentially significant impacts of these actions will be identified in greater detail.

6. Identify mitigation strategies for the potentially significant impacts identified.

7. The product of impact analysis will be embodied in a technical appendix that identifies potentially significant impacts, suggests potential mitigation strategies, and provides documentary support for the findings.

0406IAT1

AIR QUALITY

CALFED actions would affect air quality both directly (e.g., short-term emissions from construction vehicles at new facilities or long-term changes in water pump operations and resulting emissions at the CVP and SWP pumping plants) and indirectly (e.g., agricultural practices that change in response to CALFED water-efficiency policies or changes in water supply reliability that could affect regional agricultural emissions). The magnitude and measurability of these changes in air quality vary and the relative importance of each pollutant (e.g., particulate matter and carbon monoxide) varies from one geographic area to another because each region has different air quality problems.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on air quality:

- ozone (O_3),
- carbon monoxide (CO), and
- particulate matter.

Information that will be used to determine the magnitude of these changes are:

- duration using construction, agricultural, pumping, and recreational equipment and vehicles,
- acres of ground disturbance resulting from construction activities or agricultural operations,
- characteristics of soil disturbed by construction or agricultural operations (e.g., silt content, soil moisture, and vegetative or synthetic cover),
- meteorological factors (e.g., wind speed, precipitation, and temperature), and
- land use changes

The air quality assessment will focus on emission sources that would be affected either directly or indirectly by CALFED actions. Short-term construction-related activities and long-term operational activities will be assessed separately. The effects on air quality by construction, land use changes, and operational activities will be summarized by pollutant. Changes in pollutant types will be determined by evaluating expected changes in each emission-producing activity.

Assessment methods will primarily be qualatative descriptions based on the potential changes described above. Where appropriate within the programmatic assessment, CALFED staff will consider assessment methods recommended by local air quality regulatory agencies (air quality management districts). Because many air quality management district guidelines address only conventional urban development activities (e.g., residential developments, office buildings, retail complexes), the U.S. Environmental Protection Agency (EPA) document, Compilation of Air Pollutant Emission Factors, will be used to define appropriate assessment methods for other CALFED actions.

The assessment of changes in air quality will incorporate information from changes in other resource topics and operations that could affect air quality and will reference the assessment of changes to agricultural practices, soils, power production or energy consumption, and recreation resources that produce emissions.

NOISE

Actions associated with CALFED alternatives could affect noise conditions by changing the intensity and location of construction activity, changing stationary sources of noise associated with power generation, pumping and water conveyance systems, and changing the intensity and location of noise-generating recreational activities such as boating and hunting. CALFED actions could affect the various local noise environments both directly and indirectly. Direct effects would involve short-term noise from construction activities and long-term noise associated with the operation of mechanical equipment (e.g., pumps and generators) and from activities associated with land use changes. Indirect effects would involve noise from increased recreational activity, such as boating on new or expanded reservoirs and hunting in new or expanded marshland areas.

Changes in noise levels from the following sources will be evaluated to assess the impacts of the CALFED alternatives on noise:

- short-term construction activities,
- facilities operation,
- aquatic recreation (e.g., boats),
- terrestrial recreation (e.g., hunting), and
- land use changes.

The approach used to assess the potential noise effects of CALFED alternatives involves evaluating the noise effects of various component activities. The program activities will be divided into direct short-term (construction-related) activities, direct long-term (operational) activities, and indirect activities. As an example, the direct short-term effects of constructing a conveyance facility would include noise from construction equipment (i.e., grading and assembly). Direct long-term effects could involve noise from pumps if such pumps are used in new conveyance or storage facilities. An example of an indirect activity would be increased powerboat use resulting from increased available water surface area. Direct short-term activities, direct long-term activities, and indirect activities would be assessed separately.

Noise levels generated by the various types of project-related activities will be discussed and summarized at a general level of detail. The locations of potential sources of noise will be taken into consideration in evaluating potential effects. Assessment methods will primarily be qualitative descriptions considering the type and nature and changes of potential sources of noise. In addition, the geographic location of the CALFED components will be considered. For example, noise produced in a previously quiet area near sensitive noise receptors (e.g., homes, parks, recreation areas) would be of greater concern and would require more detailed assessment than noise produced in an already noisy area. Noise is typically a local issue that is regulated at the city and county level. Local guidelines and regulations relating to noise will guide regional or programmatic evaluation of noise conditions.

The assessment of noise will incorporate information from other resource topics that describe changes in operations that could affect noise conditions in the area. The noise assessment will refer to the land use section for areas of potential construction and sensitive noise areas, the power production or energy consumption assessment for changes in power production and pump activities, the recreation resources assessment for changes in recreational activities that generate noise (e.g., boating and hunting), and the traffic and navigation assessment for changes in transportation-related activities that create noise.

VISUAL RESOURCES

CALFED actions that could affect existing visual/aesthetic resources in the program region include alteration or modification of levees, construction of water storage and/or conveyance facilities, and habitat restoration activities. Changes in water storage and flow conditions may also affect visual conditions in recreation areas where water levels are a prominent visual characteristic (e.g., Shasta Lake). The process to assess visual/aesthetic resources in the CALFED region involves identifying important viewing locations, determining the quality of views, establishing the importance of views to people who visit the area, and determining the potential changes that could occur to viewed landscapes as a result of CALFED actions.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on visual resources:

- visual resource conditions (visual quality), and
- viewer response to those changes (viewer sensitivity).

Assessments of visual quality will be made relative to overall regional visual character. Viewer sensitivity will vary depending on the characteristics and preferences of the viewer group.

The visual quality of an area or view is formed by the combination of distinct landscape components, including topography, vegetation, wildlife, surface waters, and the artificial elements of the environment. Assessments of visual quality must be made with a regional frame of reference. The same landform or visual resource appearing in different geographic areas could have a different effect on the overall visual quality of the viewed landscape.

Viewer exposure refers to the location of viewer groups, the number of viewers, and the frequency and duration of views. Viewer sensitivity will vary depending on the characteristics and preferences of the viewer group. An assessment of viewer sensitivity can be made based on the extent of the public's concern for a particular landscape or for scenic quality in general.

The description and evaluation of visual/aesthetic resources in the CALFED study area involves the following steps:

- Identify the visual features or resources that compose and define the visual character of the landscapes.
- Assess the quality of the identified visual resources relative to overall regional visual character.
- Identify major viewer groups and describe viewer exposure.
- Identify the importance to people, or the viewer sensitivity, of views in the landscape.

This information will be used to identify areas of high, medium, and low visual quality and sensitivity in the program region. The benefits and adverse impacts of proposed CALFED alternatives on visual resources will be based on representative changes in visual quality of similar actions and regional visual quality information. Indirect effects of CALFED actions on visual resources may be more difficult to determine (e.g., changes in land uses that result from changes in water supply reliability). Indirect effects on visual resources would be described only briefly.

The visual resources assessment requires input from the assessment of changes in land uses, vegetation and wildlife including special-status species, and increases or decreases in recreation use at visually sensitive areas.

CULTURAL RESOURCES

The effects of CALFED alternatives on cultural resources will be analyzed at a regional level. The cultural resources analysis will describe the potential for prehistoric and historic resources to occur in each geographic regions based on the presence of specific landforms such as channel deposits and floodplains. Cultural resources could be affected by CALFED actions such as construction of new facilities and habitat and levee improvements. The indirect effects of CALFED actions on cultural resources (e.g., development of facilities that result from changes in water supply reliability) may be more difficult to determine and will be described qualitatively. Once the precise location and size of alternatives have been defined at the end of Phase II, additional efforts will be required in Phase III to identify and evaluate both prehistoric and historic resources for compliance with the National Historic Preservation Act.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on cultural resources:

- risk to prehistoric sites, and
- risk to historic sites.

Related information to be measured includes the following:

- acreage of ground disturbance from construction activities anticipated in a given region,
- distribution of culturally sensitive landforms,
- locations of known historic or prehistoric sites, and
- association of historic and prehistoric sites with land conditions.

The cultural resources assessment, based on methods developed by the U.S. Bureau of Reclamation, will determine the risk to historic and prehistoric sites using th following steps:

- identify the probability of finding a site in a given area or region (based on known site information and estimated likelihood for various landforms or other geographic conditions),
- determine the general location and estimated extent of ground disturbance that would be associated with CALFED actions, and
- calculate the relative risk to known and unknown sites.

The proposed assessment methods are presented below for prehistoric sites in the Delta, historic sites in the Delta, and prehistoric and historic sites outside the Delta.

The general locations of CALFED actions in the Delta will be compared with information about landforms in those areas to determine the potential locations of and potential effects on prehistoric sites. The presence of prehistoric sites in the Delta region can be determined using selected landforms where prehistoric sites are typically located such as channel deposits, organic soils, and basins and basin rims. Information from the land use impact assessment will also be used to determine land use changes that could affect cultural resources.

For historic sites, there is not a strong relationship between landforms and historic site location in the Delta. Additional variables need to be examined to determine whether using a geographic-based system for analysis of historic site location is appropriate. The U.S. Bureau of Reclamation anticipates conducting records searches for historic sites in the Delta to determine whether geographic conditions can be used to estimate the likelihood of sites. Development of these assessment methods is continuing.

For areas outside the Delta, the location of known prehistoric and historic sites and the potential for locating new sites will be identified based on information gathered by the U.S. Bureau of Reclamation for Central Valley Project Improvement Act Programmatic Environmental Impact Statement.

PUBLIC HEALTH AND ENVIRONMENTAL HAZARDS

The programmatic assessment for public health and environmental hazards is based on the predicted responses of disease vector and host populations and hazardous materials to CALFED actions. Mosquitos can transmit malaria and several types of encephalitis and can cause a substantial nuisance. Therefore, they are a public health concern. Other public health concerns include the transmission of Lyme disease by ticks, bubonic plague by fleas, rabies by wildlife and other animals, and the safety hazards and nuisance caused by midges. CALFED actions could affect public health by creating conditions favorable to an increase in vector populations and therefore an increase in the possibility of disease transmission by mosquito, tick, and wildlife.

Hazardous materials include both raw materials and products (e.g., fuels and oils) commonly used in commercial activities and during construction, and hazardous wastes from known and unknown sources. The assessment of hazardous materials is based on the potential for changes in exposure of people and the environment to these materials as a result of CALFED actions.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on public health and environmental hazards:

- area of mosquito breeding habitat,
- area of habitat that supports other disease vector populations,
- risk of contact between humans and vector populations, and
- risk of hazardous material and waste upset (construction and operation).

CALFED habitat restoration actions involve restoring acres of land to various habitat types. Changes in the acreage of habitats that serve as mosquito breeding habitat would require changes in the level of mosquito abatement needed for each CALFED alternative. Evaluation of mosquito breeding habitat, and habitat that supports other disease vector populations, would be conducted primarily using electronic databases of habitat-type distributions (see "Vegetation and Wildlife Including Special-Status Species").

The change in the risk of transmission of diseases by mosquitoes and other vectors (e.g., fleas) to humans under the CALFED alternatives will be assessed qualitatively based on predicted responses of vector and host populations to CALFED actions.

The assessment of the effects of CALFED actions on the relative risk of exposure of people and the environment to hazardous materials will be primarily be qualitative descriptions considering existing State, federal, and local regulations; emergency response plans; and other programs. The general geographic areas where hazardous materials or known hazardous waste sites are most likely to be encountered under a given alternative or action will be identified. The CALFED actions that could disturb areas and alter exposure to hazardous materials will be evaluated and the relative magnitude of the most important actions (i.e., construction and flooding) in areas where hazardous materials could be present will be compared to estimate the change in potential for exposure.

Public health assessment variables and methods are directly related to the assessment of impacts on habitats that support disease-vector populations and are used for recreation. These are discussed in the section on vegetation and wildlife and special-status species.

The assessment of impacts from hazardous materials is directly related to the assessment of impacts on water quality, aquatic wildlife, and aquatic habitats because of the relationship between the exposure to these materials and water quality and the subsequent effects on wildlife and habitat as a result of exposure. Information from the land use assessment will be used to determine areas of potential disturbance.

RECREATION RESOURCES

CALFED actions could affect recreation by changing waterway access, creating new recreation sources (e.g., by developing storage facilities), and changing the abundance of fish and wildlife important to recreation.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on recreation resources:

- recreation opportunities, and
- recreation use.

Recreation opportunities depend on the availability and condition of resources that may vary over time. These include access to waterways; reservoir surface area; riverflows; access to support facilities (boat ramps, marinas, campgrounds, etc.); and abundance of fish and wildlife. CALFED actions could affect boating opportunities in the Bay-Delta region by changing access to Delta sloughs, changing access to facilities such as marinas or boat launches, or affecting fishing and hunting activity by changing the abundance of sport fish and waterfowl. Factors contributing to recreation use include regional population and demographics, the demand for recreation resources, and recreation opportunities.

Both qualitative and quantitative methods can be used to assess changes in recreation opportunities. Where recreation opportunity thresholds (e.g., the reservoir level at which boat ramps become unusable) and necessary input data exist, they will be used to assess the effects of CALFED actions on recreation opportunities. In other areas, and for other activities, qualitative methods based on historical use data; availability and accessibility of recreation sites; and the abundance of fish, waterfowl, and support facilities (e.g., boat launches and marinas) will be used.

Methods for assessing changes in recreation opportunities include the following:

- Recreation opportunities within the Bay-Delta can be assessed qualitatively based on the availability and accessibility of recreation sites (e.g., Delta channels), the availability of support facilities (e.g., boat launches and marinas), and the abundance of fish or waterfowl.

- Recreation opportunities at rivers and existing reservoirs for which hydrologic modeling output would be available can be assessed quantitatively using "recreation opportunity thresholds", indicated by reservoir surface elevations or river flows that can be determined for individual recreation sites. Recreation opportunity thresholds (e.g, usable reservoir surface area, boat ramp availability) determine the frequency with which activities could be affected at each recreation area.

- Recreation opportunities at new facilities will be assessed through use of information on existing facilities with similar characteristics to predict opportunities at new facilities.

- Recreation opportunities at wildlife refuges, private hunting clubs, and coastal waters can be assessed qualitatively based on the abundance of fish or the abundance of waterfowl habitat.

The recreation-use assessment will focus on determining how annual recreation use at important recreational facilities could change under the CALFED alternatives. Recreation-use equations estimate recreation activity as a function of the environmental attributes of a recreation site (e.g., distance to population centers, fish and wildlife abundance, lake levels, water flows). Typically, these equations are based on historical recreation-use levels and environmental conditions. Existing recreation-use equations appropriate for assessment of effects of CALFED actions will be used to estimate the changes in annual recreation use under the CALFED alternatives.

Results from the assessment of effects on fisheries and aquatic resources and surface water hydrology will be required to assess effects on recreation . The fisheries analysis will provide information on how CALFED actions would affect sport-fish populations and will be used to estimate changes in sport-fishing levels at various recreation sites. The hydrology analysis will provide information on how CALFED actions would affect the availability of water for recreation resources in the study area.

Output from the recreation impact assessment will be required to assess impacts on fish, wildlife, and recreation economics. The recreation impact assessment will provide estimates of recreation use by activity and region and will be used to estimate recreation-related spending.

GEOMORPHOLOGY, SOILS, AND SEISMICITY

Geomorphology and soil conditions depend on the characteristics of the soils (e.g., erodibility, organic content), management or use of the soil (e.g., agricultural and irrigation practices), and composition and condition of underlying materials and aquifers. CALFED actions could affect soil conditions, subsidence, and seismic hazards through actions that affect the quantity and quality of irrigation water supplies to soils, changes to the amount of land under irrigation, improvements to Delta levees, relocation of infrastructure in the Delta, and changes to agricultural practices and groundwater management.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on soil conditions:

- surface soil erosion,
- soil salinity,
- subsidence caused by peat oxidation,
- subsidence caused by groundwater withdrawals,
- seismicity, and
- land use changes.

Surface soil erosion is a function of soil types and their relative erodibility, wind and water erosivity, slope and slope length, vegetation cover, and land use and management. Soil erosion is an area of concern in agricultural production.

Soil salinity is the result of salt accumulation over time in surface soils. Soil salinity is affected by the salinity of applied water, the amount of excess irrigation water applied to flush the salts, and the salinity and level of the groundwater. Soil salinity is of particular concern in the San Joaquin Valley and the southeastern areas of the Delta (near Stockton).

Oxidation of organic soils in the Delta has resulted in land subsidence. Factors affecting subsidence in the Delta include the organic content of the surface soil, soil moisture and water table management, seasonal flooding, and ground disturbance and tilling practices. Outside the Delta, land subsidence can be caused by increasing groundwater withdrawals. When an aquifer is dewatered, clay materials within the aquifer consolidate, causing the land surface above to subside. After an area has subsided, irreversible changes to the aquifer occur. Subsidence resulting from groundwater withdrawals is influenced by the groundwater levels in the aquifer, rates of recharge versus withdrawal for the aquifer, and the geology and mineralogy of the aquifer.

There is a risk that Delta island levees could fail during seismic events, and although there have been no catastrophic failures attributable to seismic events, significant damage has occurred in the form of cracks and sloughing of banks. The susceptibility of levees to failure from seismic activity (ground shaking and liquefaction) is affected by the levee material, foundation, and height.

Assessment methods will primarily be qualitative descriptions which compare differences in the rates of soil erosion, soil salinity, and subsidence between CALFED alternatives. In addition, construction-related soil erosion under the CALFED alternatives will be compared based on the

E-010142

expected area of disturbance, regional location, duration, kind of construction disturbance, and average erodibility of soils in the region.

Changes in region wide erosion rates will be derived from changes in land use and management. Estimates of changes in soil erosion will be qualitative because of variability in soil type, soil erodibility, slope, and land management throughout the region. County soil surveys and discussions with district conservationists of the Natural Resources Conservation Service (NRCS) will be used as the basis for projections of soil conditions and land use practices.

Soil salinity problems will be assessed based on the projected area of salt-affected soils. In the Delta area, soil salinity is dependent on the quality of water drawn from the Delta channels. Delta water quality models will be used to assess where salinity in Delta channels will increase or decrease, and a comparison will be made of land areas affected by changes in the quality of intake water. For the San Joaquin Valley and other water export areas affected by soil salinity because of high groundwater, differences in soil salinity problem areas will be estimated based on differences in the electrical conductivity (EC) of export water, the resultant requirements for excess irrigation water to flush salts, and the expected effect on the level of groundwater. Plans for agricultural tailwater drains will be factored in. In addition, the effect of using groundwater and project water as alternative sources will be assessed. The soil salinity assessment, performed on a county-by-county basis, will incorporate the advice of NRCS district conservationists.

Differences in subsidence from peat oxidation in the Delta will be described in terms of the area of drained peat soils and the rate of subsidence of drained areas. For example, CALFED actions that could affect subsidence include using Delta islands for water storage or wetland habitat and improving the land on which levees are built through in-Delta conveyance using setback levees.

Assessing subsidence resulting from groundwater withdrawals will be based on projected rates of subsidence by groundwater basins or irrigation districts, changes in the amounts or reliability of delivered water, and resulting changes in the rate of groundwater pumping.

The likelihood of a seismic event would not change from existing conditions, but the relative susceptibility of Delta resources and infrastructure to seismic events could be influenced by plans for improvements to levees, projected changes in the rate of subsidence, and changes in island management and land use influenced by CALFED actions.

Other assessment areas will provide inputs to the soil assessment. Projections of land use from the impact assessments for land use and agricultural economics will provide input to the assessment of erosion and subsidence. The evaluation of salinity (EC) in Delta irrigation water and export water from water quality assessments will provide data for the assessment of soil salinity impacts. Output from the evaluation of soil erosion may provide information for the air quality analysis (dust and particulate matter evaluations), and information from the geology, soils, and seismicity assessment will be used in the flood control evaluation for the Delta.

E-010143

TRAFFIC AND NAVIGATION

CALFED actions could affect existing roadway and waterway systems by changing the existing roadway infrastructure to accommodate new facilities, altering existing waterways to support water conveyance and levee improvements, increasing or decreasing roadway and waterway traffic by changing existing land uses, and creating short-term increases in road and waterway traffic and altering circulation patterns (e.g., detours and access roads) during construction.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on traffic and navigation:

- regional roadway level of service,
- roadway safety conditions,
- regional waterway traffic, and
- waterway navigation conditions.

The methods used to assess potential effects of CALFED program alternatives on traffic and navigation will qualitatively evaluate changes in road and waterway infrastructure and use. CALFED activities will be divided into direct short-term (construction-related) activities, direct long-term (operational) activities, and indirect activities. As an example, the direct short-term effects of constructing a conveyance facility would include roadway traffic (e.g., trucks) and waterway traffic (e.g., barges) and potential detours or closures of roads and waterways. Direct long-term effects could involve traffic generated by new water storage facilities (e.g., reservoirs) that draw recreationists to the area. Indirect activity would include increased power boat use resulting from increased available water surface area. Direct short-term, direct long-term, and indirect activities would be assessed separately.

The geographic location of the CALFED components will be considered. For example, waterway detours in an area of heavy recreation boating would be of greater concern and require more detailed assessment than detours in an area of low recreation use. Local and State guidelines and regulations relating to waterway and roadway traffic and safety will guide regional or programmatic evaluation of traffic and navigational conditions. Most likely, assessment of roadway and waterway traffic will focus on regional transportation corridors.

Long-term impacts on roadway traffic resulting from CALFED actions will be evaluated using information from the recreation analysis and details of the water storage and conveyance facilities. An increase in recreation will most likely result in an increase in roadway traffic. Water storage and conveyance-related CALFED actions also have the potential to alter waterways (e.g., enlarging existing water channels) and land and could substantially change boating conditions in the Delta area. Altering the size of a waterway or changes in water conveyance systems could change the types of water vehicles and water vehicle capacity and alter the amount of water flowing through the Delta region. Reduced flows could impair ships moving through the Stockton and Sacramento Deep Water Ship Channels in the Delta.

The traffic and navigation assessment variables are related to other resource assessments and methods, including those for recreation and water management facilities and operations. Additionally, results of the traffic and navigation assessment will support analysis of impacts on air quality and noise.

UTILITIES AND PUBLIC SERVICES

CALFED actions have the potential to affect utilities and public services in the Delta, San Joaquin and Sacramento Valleys, upstream areas of rivers tributary to the Delta areas, and the CVP and SWP delivery areas. CALFED actions could directly affect utility infrastructure by constructing water-related facilities that could require new or modified electrical services and lines and changing water operations that could affect flows in deepwater ship channels, and could indirectly affect public services by creating opportunities for M&I development or changes recreational uses that require emergency services. Economic growth stimulated by CALFED actions could also result in indirect demands for utilities and public services resulting from land use changes to support growing communities. The utilities and public services analysis will describe overall changes that result from implementing CALFED actions.

Changes to the following variables will be evaluated to assess the impacts of CALFED alternatives on utilities and public services:

- electrical facilities and supply,
- water conveyance facilities,
- natural gas fields and storage reservoirs,
- underground pipelines,
- transportation infrastructure (roads, railroads, bridges, ferries),
- deepwater ship channels and shipping ports,
- communication facilities, and
- police, fire, and emergency services.

Impacts of CALFED alternatives on utility infrastructure will be estimated by comparing the spacial distribution of existing infrastructure to areas of potential construction or land use changes that would result in displacement or modification of the existing infrastructure. The assessment of changes in utilities and services may depend on related resource analyses. For example, results from the water management and operations assessment using DWRSIM could provide estimates of changes in flows that affect viability of deepwater ship channels, and changes in recreation use levels will influence police and emergency service demands. Methods used to address changes in hydroelectric power supply are addressed in the section entitled "Power Production Economics" and the value of in-Delta utility infrastructure (e.g., natural gas fields, transportation infrastructure, etc.) will be used in the evaluation of flood damage as described in the "Flood Control" section.

Where applicable, information from the regional economics and demographics assessment will be used to determine the effects of regional growth on utilities and public infrastructure. Regional changes in utilities and services demands will be assessed qualitatively based on land use changes that result from population and economic growth in those areas affected by changes in water deliveries.

The analysis of utilities and public services are closely related to other resource assessments and methods including those for land use, power production economics, water facilities and operations, recreation resources, regional economics, and flood control. Results of the utilities and public services assessment will also support analysis of impacts on flood control, visual conditions, and traffic and navigation.

SOCIAL WELL-BEING

The assessment of social well-being will address the ability of people to cope with changes in economic and demographic conditions that may arise as a result of a CALFED action. Applicable assessment methods would incorporate economic and demographic data from other CALFED impact assessments and information collected from interviews with experts.

Changes to the following variables will be evaluated to assess the impacts of the CALFED alternatives on social well-being:

- community stability, and
- environmental justice.

The assessment methods will primarily be qualitative descriptions considering available community economic and demographic profiles for representative communities or social groups that could be affected by CALFED actions. Demographic data are varied and provide a range of community information including income profiles, employment rates, population growth rates, and ethnicity composition. This data will be used to determine how CALFED actions and their direct or indirect results would affect various social groups or populations within a community.

CALFED actions could affect the stability of a community by altering its demographics, such as ethnic composition. Significant population or economic changes could bring about either more or less ethnic diversity in a community. Economic or demographic changes could also affect a community's ability to provide appropriate levels of public services (e.g., education and housing) to its members. The magnitude of this impact is also a function of the existing capacity of the community to provide these services.

Economic impacts may not be distributed equally among the various communities within the proposed study area. Social impacts could vary significantly, depending on whether the impacts are concentrated and whether the community is almost entirely dependent on one particular industry (i.e., agriculture). Similarly, economic impacts may not be distributed equally among social groups (e.g., minority, low-income) within particular communities. An environmental justice analysis will be used to identify the potential for project alternatives to have disproportionately high and adverse impacts on specific communities or on specific social or cultural groups.

The proposed qualitative assessment methods for the social well-being analysis will draw on information developed as part of the regional economics analysis. This information will include, but is not limited to, estimates of employment, income, and fiscal revenues; unemployment rates; population growth rates; ethnic composition; and poverty rates.